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Preliminary report not for publication[1]

MILLING, BAKING, AND CHEMICAL EXPERIMENTS WITH HARD RED SPRING WHEAT 1956 CROP[2]

by

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1/ This is a progress report of cooperative investigations containing data, the interpretation of which may be modified by additional experimentation. Publication, display, or distribution of any data or any statements herein should not be made without prior written approval of the Crops Research Division, ARS, USDA, and the cooperating agency or agencies concerned.

2/ Cooperative investigations of the Crops Research Division, Agricultural Research Service, and the Grain Division, Agricultural Marketing Service. The samples were obtained from the cooperative experiments with the State agricultural experiment stations in the spring wheat region.

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INTRODUCTION

Samples of the standard varieties and many of the new strains of hard red spring wheats, grown in cooperative experiments in the spring wheat region of the United States 3/, are milled each year by the United States Department of Agriculture and the flours baked into bread to determine their quality characteristics.

The baking methods and techniques used on the 1956 crop were essentially the same as those used in similar work for the 1944 to the 1955 crops, inclusive, and described in previous reports.

The purpose of this report is to make available to cooperators the quality data on standard varieties, new strains, and commercial hard red spring wheat from the 1956 crop.

SOURCE OF SAMPLES

Tests were made on composite and individual samples of the uniform varieties and of many other varieties and strains grown in plot experiments at cooperating stations. These included samples grown at Madison, Wis.; Crookston, Morris, Rosemount, and Waseca, Minn.; Newell, S. Dak.; Langdon, Dickinson, Fargo, Edgeley, Minot, and Williston, N. Dak.; and Sidney, Creston, and Moccasin, Mont. Similar tests were made on Eastern and Western composites of the 18 strains of wheat grown in the uniform regional nurseries, and on the wheats from the station nurseries in Montana. Tests were also made on a number of sawfly-resistant varieties and strains of wheat grown in Montana.

There were also included 17 samples composited from samples of carlot receipts of wheat accumulated during a 90-day period of the 1956 crop movement by the Minneapolis, Duluth, and Great Falls offices of the Grain Division, Agricultural Marketing Service. These samples represent country-run receipts of the class hard red spring wheat and included only those lots that were graded No. 3 or better under the Official Grain Standards of the United States. These hereafter are referred to as commercial samples. This is the eighteenth season that such samples have been collected and tested.

3/ Ausemus, E. R. Results on spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1956. U. S. Department of Agriculture, Crops Research Division. 421 CC, 59 pp. University Farm, St. Paul 1, Minn. (Processed).

METHODS USED IN MILLING AND BAKING TESTS

After the removal of dockage, the samples were prepared for milling by use of a milling separator and a scourer (both of experimental or laboratory size). The wheat samples were tempered in two stages. The water for the first temper was added 72 hours prior to milling and the moisture content of the grain was raised to between 13.0 and 16.0 percent, depending upon the hardness of the variety, or within 1 percent of the total moisture required. The additional 1 percent of water for the second temper was added 1/2 hour before milling and the moisture content of the grain was raised to between 14.0 and 17.0 percent. The wheat was milled on a Buhler automatic laboratory flour mill provided with 3 break and 3 reduction rolls. Ten percent of the low grade flour was discarded, leaving a 90 percent patent flour which was used for the chemical and bread-baking tests. However, the flour yield data in the tables are reported on the basis of a straight grade flour (100 percent) obtained from each sample.

The test weight per bushel of each sample was determined in the laboratory on the dockage-free wheat. The protein and ash contents are reported on a 14.0-percent-moisture basis and the flour yield on a moisture-free basis.

The hardness of the grain was determined by pearling 20 grams of dockage-free whole wheat for 1 minute in a model No. 38 Strong-Scott pearler. The amount of material pearled off, expressed as a percentage of the wheat, is called the pearling index. This index has been found useful, not only as a guide in tempering the samples for milling, but also as a measure of the hardness of the grain. A low index figure indicates hard grain and a high index figure indicates soft grain.

The bread-baking tests on the 1956 samples were made by a rich formula with none or varying amounts of potassium bromate added.

This method with the various ingredients used in 1956 is shown in table 1.

Table 1.--Baking method and ingredients used for samples of the 1956 crop.

Ingredients and treatment	Weight of ingredients, etc.
Flour (grams)	100.0
Yeast (grams)	2.0
Salt (grams)	1.5
Sugar (grams)	5.0
Potassium bromate 1/ (milligrams)	Optimum
Malted wheat flour (grams)	.25
Nonfat dry milk (grams)	4.0
Shortening (grams)	3.0
Water absorption (percent)	Optimum
Mixing time (minutes)	Optimum
Fermentation time (minutes)	180
Handling of dough	1st punch after 105 minutes 2nd punch after additional 50 minutes Mold after additional 25 minutes Proofing time - 55 minutes Baked 25 minutes at 440° F.

1/ Zero to 3 mgs. of potassium bromate used as necessary to obtain maximum loaf volume.

This baking procedure is based on the method of the American Association of Cereal Chemists with certain modifications deemed necessary for unbleached, experimentally milled flour. Two changes in the baking procedure were made in 1956 as follows: The oven temperature was reduced from 450° F. to 440° F., and the low-sided pans were used instead of the tall pans.

A check or standard flour (12.5 percent protein and 0.50 percent ash on a 14.0-percent-moisture basis) was included in the baking trials with each day's test. The average loaf volume of the bread-baking tests were made with the standard flour was 851 cc. and the standard error was 20.7 cc. On this basis the least significant difference between 2 single bakes is 58 cc.

The undesirable properties of each variety with respect to loaf volume, crumb grain, and color characteristics of the bread are indicated in the tables by "q" for questionable and "u" for unsatisfactory, adjacent to the numerical data pertaining to the property in question. No letter or other symbol with the numerical score is used to indicate a satisfactory rating. The following scores may be used as an index for judging the crumb grain and color and the quality of the bread:

59 or below	Very poor or unsatisfactory
60 to 69	Poor or questionable
70 to 79	Fair
80 to 89	Good
90 to 99	Very good
100 and above	Excellent

An unsatisfactory rating on one or more of the properties indicates that the variety or strain is generally undesirable for hard wheat milling or bread-making purposes except that a questionable rating on one or more of the quality properties may be balanced by other outstanding properties. The milling properties are discussed in the text and should be considered along with the bread-baking properties. Bread loaf volume must also be adequate for the protein content of the flour if the variety is to be considered satisfactory. The loaf volumes are shown in the tables on an "as is" protein basis.

Loaf volume depends both on the quantity and also the quality of the gluten in the flour. In order to express loaf volume data in terms that tend to reflect only gluten quality, a value known for the purpose of this study as "specific loaf volume" was calculated by the formula:

$$V_s = \frac{V - K}{P}$$

where V_s = specific loaf volume
V = actual loaf volume in cc's
K = theoretical volume of a loaf made from flour containing no protein
P = percent of protein in the flour (14% moisture basis)

The value of K was determined by extrapolating the regression line of loaf volume against protein percentage to a protein value of zero percent. The value obtained was 160 ml. and closely approximated the actual loaf volume obtained by baking a loaf of bread in which starch was substituted for the flour in the bread formula.

Data for specific loaf volume are given in tables.

Data from the sedimentation test and mixogram curves are shown forpart of the samples tested this season. These tests provide additional information on the quality characteristics of the strains and varieties.

The sedimentation test is intended as a rough measure of bread-baking strength. Sedimentation values depend largely on the quantity and quality of the wheat gluten. High sedimentation values are associated with high-bread-baking strength.

The mixogram curves provide information on the dough-mixing properties of the flour milled from the strains and varieties. A very rapid curve rise to the peak showing a short mixing requirement and a quick decrease in curve height following the peak, denote a lack of dough stability during mixing. In general, a gradual curve rise with a slow decline in the curve after reaching the peak indicates a dough of good stability during mixing. The results of the mixogram patterns or curves have been studied and their significance as relating to the strain or variety is discussed in the text.

EXPERIMENTAL RESULTS

Station Plot Experiments

The quality data for the uniform varieties and others grown in plots are shown in table 2.

Wisconsin - Wisconsin samples were received only from Madison. The varieties made, with one or two exceptions, generally satisfactory bread with the differences in quality not very great between any of them. Most of the samples produced bread that was satisfactory in grain and color of crumb with some slightly better than others.

The dough-mixing time was very good, varying from 2 minutes to 2.75 minutes.

Most of the samples milled satisfactorily with the exception of Lee, R.L. 2563 x Lee and Lee x Mida Sib (Ns 3880.227) which were hard to reduce and the midds were tough. Lee and ND 3 produced a flour with low yield and high ash content. Lee x Mida Sib milled only fair, the midds were a little tough and slightly hard to reduce.

Table 2. Yield, milling, baking, and chemical results for hard red spring wheats grown in replicated "plots" in 1956.

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Co.	Score	Score	Co.
Madison, Wisconsin															
Henry	12265	58.7	34	13.6	12.6	76.7	.55	62	2.00	46	2	930	85	95	61
Thatcher	10003	59.2	24	14.3	13.3	71.9	.54	64	2.00	56	1	940	85	90	59
Lee	12488	58.5	28	16.6	15.4	67.0	.57	67	2.25	63	1	943	90	85	51
Selkirk	13100	58.6	33	15.6	14.6	75.2	.54	68	2.00	66	2	950	95	85	54
Russell	12484	58.6	29	13.9	12.5	73.1	.47	65	2.25	60	2	900	90	85	59
Conley	13157	58.9	29	14.8	13.5	72.7	.50	70	2.75	66	2	938	85	85	58
Henry x Supresa		60.4	30	14.9	13.2	74.3	.50	62	2.00	53	1	900	85	85	56
R.L. 2563 x Lee	13159	59.0	26	15.3	14.8	68.1	.62	65	2.00	53	1	895	90	90	50
Lee x Mida Sib	13043	59.6	29	16.4	14.8	71.0	.54	66	2.00	64	2	923	85	90	52
H441b-15-2-2-3	12632	59.4	30	17.0	15.3	72.3	.54	65	2.25	67	2	970	80	90	53
H441b-15-2-2-4		59.4	31	16.9	15.7	71.7	.53	66	2.25	67	2	1010	85	85	54
Crookston, Minnesota															
Thatcher	10003	61.1	28	11.9	11.5	74.2	.48	65	2.25	43	1	823	80	85	58
Henry	12265	61.2	37	10.8	9.8	77.3	.44	62	2.00	35	2	793	75	90	65
Rushmore	12273	61.0	33	12.4	11.5	75.7	.46	66	2.50	45	2	745	70	85	51
Conley	13157	61.3	33	13.6	12.8	76.6	.41	70	2.50	61	1	890	90	95	57
R.L. 2563 x Lee	13159	61.3	27	12.5	11.9	74.1	.53	68	2.25	37	1	805	80	100	54
Russell	12484	61.5	34	11.6	10.4	76.7	.40	65	2.25	44	1	768	75	85	58
Mida	12008	61.9	31	11.8	10.9	76.3	.47	64	2.50	39	1	748	85	95	54
Lee	12488	61.6	32	13.3	12.2	72.6	.44	67	2.00	49	1	845	90	90	56
Lee x Mida Sib	13043	61.7	30	13.3	12.4	75.1	.45	65	2.00	49	2	845	90	100	55
Selkirk	13100	60.3	33	12.0	11.2	76.5	.48	66	2.25	39	2	833	85	95	60
Morris, Minnesota															
Thatcher	10003	59.0	26	12.0	10.8	71.3	.48	64	2.50	42	2	733	70	80	53
Henry	12265	58.4	37	11.1	9.9	76.1	.43	62	2.25	34	2	730	70	75	58
R.L. 2563 x Lee	13159	58.9	27	11.9	10.6	74.1	.58	64	2.50	31	2	710	80	80	52
Lee x Mida	13043	60.0	31	12.2	11.0	72.9	.49	69	2.50	41	1	735	85	90	52
Lee	12488	58.6	32	12.3	11.2	70.3	.51	69	2.50	45	2	710	75	85	49
Rushmore	12273	59.0	34	12.3	11.3	74.4	.46	68	2.75	49	1	688	70	80	47
Mida	12008	60.5	32	12.1	10.9	72.9	.50	69	2.50	44	1	698	75	80	49
Conley	13157	59.8	30	11.6	10.7	71.1	.44	66	2.75	47	1	665	80	80	47
Selkirk	13100	57.0	31	10.6	9.9	74.3	.50	64	2.50	37	1	700	75	80	55
Russell	12484	58.7	34	10.7	9.2	74.1	.44	63	3.00	40	2	680	70	85	57

Table 2.—Continued.

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Co.	Score	Score	Co.
Rosemount, Minnesota															
Lee x Mida Sib	13043	56.5	25	15.4	13.8	71.7	.45	66	2.50	56	1	890	75	90	53
Russell	12484	57.0	26	13.6	12.2	74.5	.40	60	3.00	-	1	803	80	90	53
Thatcher	10003	54.1	23	15.1	13.8	71.1	.50	67	3.00	68	2	843	70	90	49
Mida	12008	57.4	27	14.4	13.0	74.6	.45	65	2.50	59	1	828	80	90	51
Henry	12265	56.3	30	13.6	12.3	75.5	.42	61	2.50	58	2	895	75	100	60
Lee	12488	54.4	25	15.9	14.6	71.0	.51	66	2.75	59	1	853	85	95	47
Rushmore	12273	56.5	26	15.5	14.4	75.6	.48	64	2.75	63	2	850	75	95	48
R.L. 2563 x Lee	13159	55.3	24	15.8	14.9	72.9	.61	67	2.50	46	2	883	85	100	49
Conley	13157	56.2	26	15.1	13.8	73.7	.45	65	2.75	66	1	868	85	90	51
Selkirk	13100	54.6	27	15.3	14.4	75.4	.49	65	2.50	61	2	990	90	90	58
Waseca, Minnesota															
Thatcher	10003	57.0	28	14.9	13.5	71.7	.47	64	2.25	62	1	903	75	100	55
Rushmore	12273	58.0	34	14.7	13.3	76.0	.50	65	2.50	60	2	900	75	95	56
Mida	12008	58.2	32	14.8	13.7	75.2	.48	65	2.25	57	1	885	80	90	53
Selkirk	13100	55.0	31	15.2	14.1	72.8	.51	65	2.00	62	2	975	75	90	58
Lee x Mida	13043	59.4	28	15.6	14.3	70.5	.47	64	2.50	64	1	898	75	90	52
R.L. 2563 x Lee	13159	58.0	26	15.2	14.2	69.7	.61	69	2.50	50	1	885	85	95	51
Conley	13157	57.2	29	14.6	13.4	73.6	.50	65	2.50	64	2	848	85	90	51
Henry	12265	56.2	38	13.6	12.4	72.7	.47	65	2.25	61	1	855	70	90	56
Russell	12484	57.7	31	13.9	12.5	72.1	.43	64	2.25	70	1	835	90	85	54
Lee	12488	57.5	29	15.6	15.0	68.9	.50	67	2.75	67	1	900	85	90	49
Newell, South Dakota (Irrigated)															
Conley	13157	58.0	27	15.4	14.5	73.7	.48	67	2.25	64	2	995	90	100	58
R.L. 2563 x Lee	13159	58.2	24	16.0	15.2	67.9	.62	67	2.00	39	1	880	80	85	47
Lee x Mida Sib	13043	61.0	28	15.5	14.4	69.9	.48	65	2.00	52	1	925	95	95	53
Mida	12008	60.5	27	15.2	14.0	73.3	.50	68	2.50	54	2	865	85	80	56
Thatcher	10003	59.5	26	15.4	14.5	73.1	.48	64	2.25	61	1	1023	90	95	60
Lee	12488	60.5	31	16.0	15.4	70.8	.49	65	2.00	50	2	945	100	100	51
Rushmore	12273	59.8	32	16.0	14.9	75.0	.49	64	2.00	60	1	1033	95	95	59
Selkirk	13100	56.4	29	15.3	14.7	75.4	.50	64	1.50	64	1	1033	85	95	59
Rushmore x Haynes (Bluestem)	13162	59.6	28	16.0	15.5	74.0	.48	60	1.50	60	1	928	95	100	50
Spinkcota	12375	60.2	31	16.6	16.1	72.2	.52	60	1.75	60	2	1038	85	85	55
NN1953 x Lee	13242	59.0	28	14.7	14.1	73.2	.46	62	2.25	64	2	903	85	95	53
Lee x NN1831	13243	59.8	27	14.3	14.0	73.1	.49	63	2.00	46	1	890	90	90	52

Table 2.—Continued.

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Dickinson, North Dakota															
Thatcher	10003	60.1	36	15.3	15.0	72.6	.38	63	2.00	70	2	1025	80	85	58
Conley	13157	59.7	36	16.0	15.8	73.4	.39	66	2.25	72	1	1010	95	90	54
R.L. 2563 x Lee	13159	59.7	35	16.0	15.0	71.3	.44	64	2.00	68	2	993	90	95	56
Selkirk	13100	58.5	38	15.5	14.7	73.3	.41	65	2.00	71	2	1048	95	95	60
Lee	12488	58.4	35	15.3	14.9	70.0	.41	67	2.25	70	2	970	90	100	54
Mida	12008	61.0	37	15.5	14.2	72.6	.40	69	2.25	70	1	915	90	90	53
Lee x Mida Sib	13043	59.7	35	16.4	15.1	71.3	.40	65	2.00	72	2	950	85	85	52
Edgeley, North Dakota															
Thatcher	10003	58.6	33	12.7	12.1	75.0	.47	68	2.75	67	1	850	75	90	57
Selkirk	13100	57.5	36	13.1	12.2	75.7	.42	67	2.50	68	2	848	90	100	56
Mida	12008	60.5	38	12.6	11.6	75.4	.41	65	2.50	64	1	785	90	100	54
Conley	13157	59.8	33	12.6	11.9	75.3	.43	69	3.00	68	2	823	90	95	56
Lee x Mida Sib	13043	60.2	34	14.3	13.3	73.9	.39	69	2.50	68	1	905	90	95	56
R.L. 2563 x Lee	13159	59.3	29	12.9	12.2	72.8	.49	68	3.00	61	1	845	90	90	56
Lee	12488	59.4	36	14.3	13.4	71.3	.42	69	3.00	55	1	910	100	100	56
Fargo, North Dakota															
Lee	12488	61.3	32	15.1	13.9	70.5	.44	71	2.50	69	1	908	85	95	54
Lee x Mida Sib	13043	61.4	32	15.2	14.4	70.3	.42	70	2.25	69	1	922	90	100	53
Conley	13157	61.2	32	14.6	13.9	74.3	.41	74	2.75	70	2	920	85	90	55
Thatcher	10003	61.8	30	14.4	13.8	70.3	.44	71	2.00	68	2	920	85	90	55
Mida	12008	62.0	32	14.2	13.4	74.4	.43	70	2.25	64	1	850	95	85	51
Selkirk	13100	61.1	35	14.6	13.7	77.2	.42	69	2.25	70	2	983	95	95	60

Table 2.—Continued.

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Langdon, North Dakota															
Thatcher	10003	59.7	25	13.9	12.9	73.0	.46	70	2.75	61	1	885	85	95	56
Conley	13157	58.5	26	13.4	12.8	73.0	.43	68	2.50	67	2	830	85	95	52
Lee x Mida Sib	13043	60.2	26	14.1	13.8	71.0	.44	67	2.50	66	1	845	80	90	50
Mida	12008	60.8	28	14.0	12.8	73.7	.47	67	2.25	64	1	850	85	90	54
Selkirk	13100	59.2	29	13.8	12.7	74.2	.44	66	2.50	64	2	845	85	95	54
R.L. 2563 x Lee	13159	58.7	25	14.3	13.6	69.7	.50	69	2.25	61	1	828	80	85	49
Lee	12488	60.1	28	14.4	13.4	71.3	.45	67	2.25	65	2	865	80	90	53
Minot, North Dakota															
Mida	12008	63.2	33	14.9	14.3	75.0	.48	68	2.50	69	1	900	90	90	52
R.L. 2563 x Lee	13159	61.0	29	15.5	14.8	71.9	.51	65	2.25	66	2	915	90	90	51
Conley	13157	60.3	30	15.4	14.8	73.9	.46	66	2.75	71	2	970	95	95	55
Lee	12488	62.3	34	15.5	14.7	70.9	.42	70	2.50	70	1	960	95	90	54
Lee x Mida Sib	13043	61.5	29	15.3	14.5	71.5	.45	65	2.50	71	2	948	80	85	54
Selkirk	13100	61.0	34	14.2	13.2	75.3	.45	67	2.25	67	2	930	85	85	58
Thatcher	10003	62.0	31	14.8	14.5	72.5	.43	68	2.25	70	2	973	85	90	56
Williston, North Dakota															
Thatcher	10003	59.9	39	16.5	16.0	69.8	.42	64	2.00	68	2	1080	85	80	58
Selkirk	13100	58.1	34	15.5	14.8	71.6	.45	63	2.25	68	1	995	95	95	56
Mida	12008	61.0	34	14.8	13.9	71.4	.43	63	2.25	61	1	958	90	90	57
Lee	12488	60.1	37	16.3	15.3	68.8	.42	65	2.50	68	2	1008	85	85	55
Conley	13157	59.7	40	16.2	15.8	68.5	.36	67	2.50	68	1	1075	100	95	58
Lee x Mida Sib	13043	60.9	35	15.5	14.6	68.2	.39	68	2.25	64	1	993	90	100	57
R.L. 2563 x Lee	13159	60.3	31	15.6	15.0	71.1	.46	66	2.50	60	1	955	95	100	53

Table 2.--Continued.

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Creston, Montana (Irrigated)															
1520 x 1752	13041	62.7	31	13.1	12.3	71.0	.46	64	2.00	43	1	740	80	80	47
Pilot	11945	61.1	30	12.0	11.0	71.5	.41	62	2.00	42	2	720	90	80	51
Thatcher	10003	59.6	32	13.7	13.1	69.8	.48	63	1.75	49	2	855	90	85	53
Centana	12974	61.6	32	12.9	11.7	70.6	.38	64	1.75	49	2	733	95	85	49
Creston, Montana (Dryland)															
1520 x 1752	13041	60.0	36	15.7	14.7	73.8	.37	62	1.75	59	1	940	90	95	53
Pilot	11945	57.4	33	15.5	13.9	71.0	.34	62	2.00	69	1	1020	95	90	62
Thatcher	10003	57.1	38	16.0	15.2	71.0	.34	62	1.75	65	2	1018	90	95	56
Centana	12974	58.9	35	15.5	14.5	69.8	.32	62	1.75	70	2	1035	90	80	60
Moccasin, Montana															
Conley	13157	57.7	33	15.6	15.1	76.7	.41	67	2.50	71	2	1035	90	90	58
Lee	12488	59.3	33	15.2	14.6	74.0	.41	68	2.50	70	2	985	80	90	57
Selkirk	13100	55.7	32	15.7	15.0	74.9	.42	68	2.25	72	2	1095	80	90	62
Thatcher	10003	56.5	29	17.0	16.0	71.8	.42	69	2.25	72	3	1105	70	85	59
Sidney, Montana															
Thatcher	10003	59.7	41	17.1	15.8	69.4	.42	62	2.00	67	2	1048	95	95	56
Conley	13157	59.9	41	16.8	15.8	69.8	.40	65	2.00	69	1	1045	95	100	56
Lee	12488	59.9	43	17.3	16.1	67.9	.41	66	2.00	68	1	1020	90	95	53
Selkirk	13100	59.8	44	16.3	15.3	73.8	.43	65	2.00	69	2	1015	95	95	56

The dough-handling characteristics of the samples were very good being very mellow and pliable with the possible exception of Selkirk and Lee x Mida Sib which were slightly sticky. Sample R.L. 2563 x Lee produced a flour with high ash content and a low flour yield. Lee also produced a low yield of flour and a slightly higher ash than the other samples in this group. All the other varieties produced a very good flour yield. The flour ash of all varieties was slightly higher than expected for hard red spring wheats ranging from 0.47 percent for Russell to 0.62 percent for R.L. 2563 x Lee. The two crosses H 44lb-15-2-2-3 and -4 were highest of the Wisconsin samples in sedimentation value and protein content. Both have made very good bread.

Minnesota - Samples were received from four Minnesota stations, Rosemount, Crookston, Morris, and Waseca.

The samples from Rosemount and Waseca, Minnesota, were generally higher in protein content than the wheats from the other two stations. This accounts to a large extent for the higher loaf volumes of the bread from these stations as compared with those samples from Crookston and Morris, Minnesota. The Morris, Minnesota samples produced bread that was generally lower in grain characteristics than that from the other three stations. None of the varieties and strains had short dough-mixing times, an objectionable property of some of the new strains tested in past years. The dough-mixing tolerance was satisfactory, as would be expected for samples having dough-mixing times as long as these Minnesota samples. There was some variation in the water absorption of the samples which appears to be related to both softness of the kernel and the protein content of the flours.

The varieties making the best bread from the Minnesota stations were for the most part the approved hard red spring wheats. These were Thatcher, Mida, Lee, Selkirk, Conley, and Rushmore. All milled satisfactorily and produced, with some exceptions, about the yield of flour expected according to the test weight of the varieties. Mida and Rushmore appear to be the best in yield of flour among the varieties and produced more flour than expected in accordance with their test weights. Thatcher was perhaps strongest in dough-handling properties, followed by Selkirk, Lee, and Conley. Rushmore and Mida were rated next in dough characteristics.

Russell and Henry produced doughs of fairly good quality, had medium high water absorptions, and their mixing times were about the same as that of the approved hard red spring varieties. The quality of these two varieties is not as strong as either Lee or Conley, but they made fair to good bread. At three of the stations the grain of the bread was equal, if not better, than that of some of the approved varieties. The variety Henry has a high pearling value. It mills softer, producing a flour not as granular to the feel as that from Thatcher, Selkirk, and Lee. The yield of flour for Henry has been high, generally exceeding that of the approved hard red spring varieties. Russell appears to be the stronger of the two wheats, considering the data as a whole.

The dough properties of Lee x Mida Sib (Ns 3880.227) were more mellow than those of Lee and Selkirk. Some of the samples showed a tendency to be sticky with others having good handling properties. The dough-mixing patterns determined by the mixograph showed that the mixing tolerance was generally shorter than those of the approved varieties. The dough-mixing times of Lee x Mida Sib appear to be longer than those of last year's samples. This strain does not generally have the strength looked for in a strong type wheat. Perhaps the most unsatisfactory property of the strain is in its dough-handling characteristics which appear to be variable, but questionable on about half of the samples tested.

The ash content of the flour from R.L. 2563 x Lee (ND 3) was extremely high at all stations, indicative possibly of an inherent property.

South Dakota - South Dakota samples were received only from Newell (irrigated trials). The Newell samples were high in protein with all except two of them testing higher than 15.0 percent protein in the wheat. The wheats lowest in protein were NN 1953 x Lee (B52-91) and Lee x 1831 (B52-119). The wheats having the best quality for bread appear to be from Conley. Thatcher, Lee, Rushmore, and Selkirk.

The milling characteristics of R.L. 2563 x Lee (ND 3) and Lee x Mida Sib (Ns 3880.227) were unsatisfactory, the middlings being tough and hard to reduce to flour. The yield of flour was lower than expected for wheats having test weights per bushel in the range of these. The ash content of the flour was high for strain R.L. 2563 x Lee and exceeded that of the flour from Thatcher, Mida, or Selkirk.

Strain NN 1953 x Lee milled slightly soft for a hard red spring wheat, but had a very good flour yield and in general milled satisfactorily. All the other samples from this station milled good or very good, and produced an exceptionally high yield of flour when considered in relation to the test weight per bushel of the grain. Spinkcota, unlike samples in past years was harder in kernel texture and milled relatively good. It has milled unsatisfactorily in most tests, the middlings being difficult to reduce to flour and the flour yield lower than expected considering the test weight of the sample. Past years' results have shown Spinkcota to be of questionable quality for bread.

Selkirk, Rushmore x Haynes and Spinkcota had the shortest dough-mixing times of the samples tested in this group. Strains R.L. 2563 x Lee, Lee x Mida Sib, Rushmore x Haynes, and Lee x NN 1831 had poor dough characteristics that were sticky and difficult to handle in the bread-making process.

North Dakota - Samples were received from six North Dakota stations, Minot, Dickinson, Fargo, Edgeley, Williston, and Langdon.

Most of the samples made reasonably good bread with not a very great range in quality between the varieties and strains. The protein content was generally higher in the Williston and Dickinson, North Dakota, samples followed by the samples from Minot and Fargo. No doubt this better protein content accounts, in part, for the generally better loaf volumes obtained on the Williston and Dickinson samples.

The flour yield of strain R.L. 2563 x Lee (ND 3) was lower than expected for the test weight per bushel of the samples and also when compared with the approved hard red spring varieties of the same test weight. Strain ND 3 averaged generally higher in ash content of flour and lower in crumb color than Mida or Selkirk. The dough properties of Lee x Mida Sib (Ns 3880.227) showed a tendency to be sticky and were more mellow than those of Lee and Selkirk. The other strains and varieties had good dough-handling properties. The dough-mixing patterns determined by the mixograph showed that the mixing tolerance was generally shorter than those of the approved varieties.

Most of the varieties and strains tested from these six stations produced better crumb color in the bread than that of Thatcher. The variety Conley, recently named, was one of the better wheats in yield of flour.

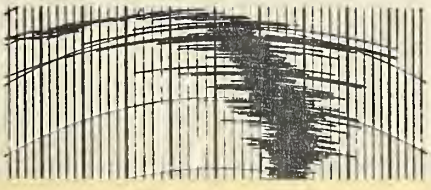
Thatcher, Conley, Selkirk, and Lee, considering the data as a whole, appear to be the best quality wheats from the North Dakota stations.

Montana - Samples were received from Moccasin, Sidney, and from Creston, where at the latter station the same varieties and strains were grown on both irrigated and dryland.

The Sidney varieties were the highest in protein content of the samples tested in 1956. None was lower than 16.3 percent in wheat protein content. Thatcher and Conley made the best bread considering the data as a whole. Selkirk and Lee were nearly as good. All produced bread having very satisfactory grain. Selkirk was best of the four in flour yield.

Conley was best of the Moccasin uniform varieties. It was also highest of the station samples in flour yield. The other wheats were nearly as good being degraded slightly because of loaf volume and/or internal bread properties. All the Montana samples, however, made satisfactory bread.

At Creston the dryland samples were highest in wheat protein content exceeding the irrigated samples from 2.3 to 3.5 percent when compared by strain or variety. This difference in protein will account, to a large extent, for the better bread-baking properties of the dryland than that of the irrigated grown wheats. Another marked difference between the wheats grown at Creston under the two different conditions is the relatively lower ash content of the flours produced from the dryland samples as compared with the ones grown on irrigated land. One other difference was the test weight per bushel of the dryland samples which averaged lower than the wheats produced on irrigated land.



The quality results for the varieties and strains will be discussed, to a large extent, on a consideration of the data as a whole. The approved and named hard red spring varieties, Thatcher and Pilot made satisfactory bread. Thatcher was the stronger of the two in quality and showed good dough strength in the bread-making process. Pilot produced good bread, but the dough-handling properties were not considered as strong as those found in the variety Thatcher. The mixogram pattern or curve (fig. 1) shows that irrigated grown Pilot is perhaps not as strong as the comparably grown Thatcher. Grown under dryland conditions, however, both appeared to be equally satisfactory and produced a relatively strong mixogram pattern.

The irrigated grown Strain 1520 x 1752 (N2389) milled unsatisfactorily. The middlings were found tough and difficult to reduce to flour. It was considered as having only fair milling properties and produced less flour than expected considering the test weight per bushel of the grain. The dough-handling properties were satisfactory and equal to the approved hard red spring varieties. The mixogram pattern or curve was relatively strong. The internal bread properties were medium good, but the loaf volume was lower than expected considering the protein content of the sample. The protein content in the flour of N2389 was 1.3 percent higher than that of Pilot, yet both wheats produced bread having practically the same loaf volumes.

It is evident that Strain N2389 produced less loaf volume per unit of protein than Pilot. This is shown further by the lower specific loaf volume value for N2389. The specific loaf volume value is a measure that tends to reflect only the quality of the gluten in the flour without reference to the protein content.

The Creston, Montana, dryland grown N2389 wheat was much superior in quality to the irrigated grown grain. The dryland sample, however, had a tendency to produce a relatively lower loaf volume than might be expected for the protein content of the wheat, and was similar in this respect to the irrigated sample. Otherwise, the dryland Strain N2389 showed good milling and baking properties. The loaves from the dryland sample made bread of excellent color and grain of crumb. The dryland grown N2389 is the more promising of the samples grown under two different conditions.

Centana (Pilot^2 x Thatcher, N2170), made a better showing quality-wise when grown on dryland than when grown under irrigation. The difference was principally in the protein content where the dryland sample was highest. Centana, considering the data as a whole, milled satisfactorily and produced a good yield of flour in relation to the test weights of the samples. The dough properties of Centana, which were elastic and pliable, have been found somewhat more mellow than those of Thatcher. The bread made from the samples produced good color and grain. The loaf volume for the dryland sample was high and about that expected for the protein content. The loaf volume for the irrigated sample was lower than expected, especially when considered in relation to the protein content of the flour. The mixogram curves of both samples of Centana appear to be generally similar to the comparable grown Pilot. Centana has many good quality properties that make it a promising variety.

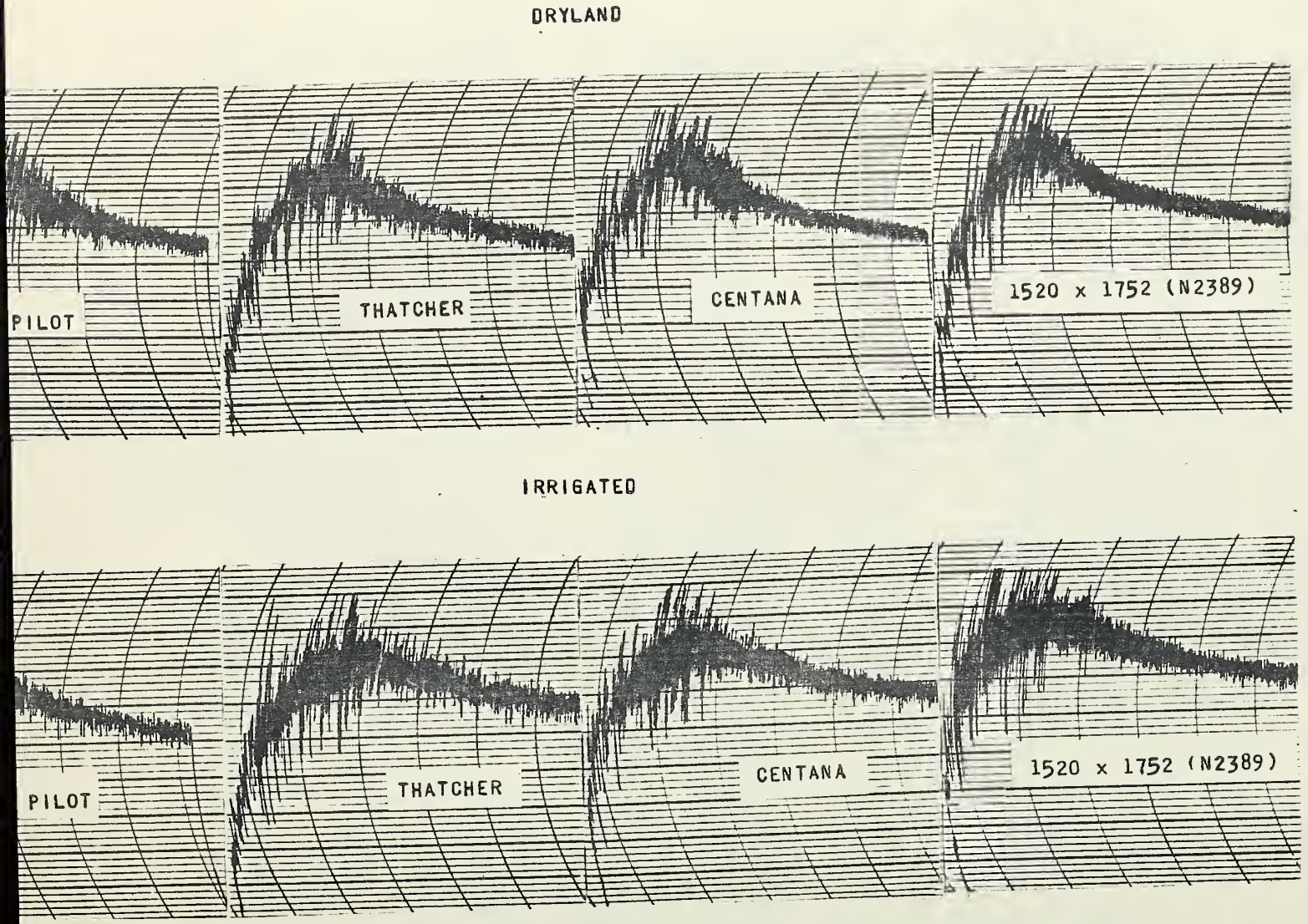


FIGURE 1. MIXOGRAM CURVES OF THE CRESTON MONTANA (DRYLAND AND IRRIGATED) SAMPLES

Uniform Regional Nursery

Eighteen wheats from the uniform regional nursery have been tested in duplicate for their milling, baking, and chemical properties. These consisted of an eastern composite of grain from 6 stations and a western composite of grain from 5 stations.

The results of the quality tests for the eastern and western composites and the averages of both are shown in table 3. The discussion of these samples will be based principally on the averages, except possibly for some reference for the purposes of comparison, to the results obtained on the same varieties and strains grown at either the eastern or western composite stations.

Most of the samples from the uniform regional nurseries made reasonably good bread with not a very great range in quality between many of the varieties and strains.

In some years the properties or characteristics of the same variety or strain grown at the eastern or western composite stations are relatively different due, no doubt, to a difference in environmental conditions. The differences in quality this year between the samples in the two nurseries were relatively small. In general, the western nursery samples have been in some years the strongest in quality of the two composites.

The loaf volumes were slightly higher and the crumb color and grain of the bread better for the western than the eastern nursery samples. The protein content of the samples compared by variety and strain for both composites were, with few exceptions, very much alike. The only exceptions to this were Marquis and Thatcher which were moderately higher and K338AA x N2350 (ND 48) and Lee x 1831 (B52-119), which were lower in protein content in the western than for the eastern nursery.

The water absorption in the western composite varied within the narrow range of 63 to 67 percent, but in the eastern composite it was greater, varying from 62 to 71 percent. In general, the water absorption averaged 3.0 to 4.0 percent lower for the western than the eastern nursery samples. The dough-mixing times were about medium to long, and the flour ash content relatively low for the western samples. A number of varieties and strains produced flour having a relatively low ash content ranging from .36 to .39 percent. The flour ash content averaged much higher in the eastern samples. The bromate requirements averaged about the same for the western and the eastern samples.

The approved and named hard red spring varieties, Marquis, Thatcher, Selkirk, Lee, and Conley, made satisfactory bread. Thatcher, was perhaps the strongest of these in quality and showed good dough strength in the bread-making process. Selkirk produced the highest yield of flour of the 5 varieties averaging about 2.0 to 3.0 percent higher than the other 4 samples.

Table 3.—Milling, baking, and chemical results on 18 wheats grown in the Uniform Regional Nursery for the Eastern Composite, Western Composite, and the averages of the Eastern and Western Composites in 1956.

Eastern Composite[1/]

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb		
													Color	Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Marquis	3641	57.4	28	14.1	13.2	72.0	.59	66	2.25	66	2	893	90	90	56
Thatcher	10003	59.3	27	15.2	14.3	72.1	.53	66	2.50	67	2	958	80	85	56
Selkirk	13100	58.1	33	15.5	14.6	74.5	.53	67	2.50	68	2	943	90	100	54
Lee	12488	59.2	30	16.4	15.2	69.3	.52	69	2.75	69	2	910	85	95	49
Lee^6 x Kenya Farmer	13221	58.9	30	16.0	15.3	69.7	.54	69	2.25	66	1	930	85	90	50
Conley	13157	59.1	30	15.5	14.9	71.5	.51	69	2.75	70	2	918	85	85	51
R.L. 2563 x Lee	13159	58.9	27	15.8	14.9	70.1	.61	71	2.25	55	2	873	90	80	48
Thatcher x K338AC	13204	58.6	35	15.9	14.6	72.4	.55	68	2.50	71	2	955	90	85	54
Rushmore x K338	13205	58.7	34	15.7	14.0	74.0	.57	69	2.25	68	1	955	85	90	57
Ditto	13206	60.0	31	16.1	14.4	71.5	.54	66	2.75	71	2	915	90	95	52
N2350 x 4021-K338AC	13222	61.1	29	16.0	14.5	72.9	.48	70	2.50	71	1	923	90	85	53
N2350 x Th.-K338AC	13223	60.9	33	15.7	14.6	72.8	.42	62	2.50	72	1	925	95	90	52
K338AA x N2350	13224	59.4	26	15.8	14.8	72.2	.50	69	2.00	70	2	985	90	85	56
K338AA x Ns3880.191	13301	61.4	28	15.4	14.5	71.1	.51	71	2.75	67	2	955	70	85	55
Ditto	13302	61.7	28	15.9	14.8	72.2	.52	69	2.50	65	2	895	90	85	50
Thatcher x Kenya Farmer	13211	61.6	35	15.4	13.8	71.9	.46	67	2.50	61	2	875	85	85	52
1953 x Lee	13242	60.1	31	15.0	13.8	68.6	.47	70	2.50	67	1	860	90	90	51
Lee x 1831	13243	59.4	30	15.1	14.8	69.2	.57	71	2.75	63	1	883	85	90	49

1/ Composite of seed from St. Paul, Waseca, Crookston, Morris, Madison, and Fargo.

Table 3.—Continued.

Western Composite[1/]

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Marquis	3641	59.6	34	15.4	14.5	69.5	.41	65	2.00	73	2	990	90	90	57
Thatcher	10003	59.2	33	15.9	15.1	69.0	.39	66	2.50	72	1	1020	90	90	57
Selkirk	13100	58.1	36	15.3	14.6	71.3	.39	66	2.50	72	2	980	80	85	56
Lee	12488	59.3	37	16.1	14.9	69.5	.41	65	2.25	68	2	938	90	90	52
Lee[6] x Kenya Farmer	13221	59.6	36	15.9	15.4	66.2	.39	67	2.25	72	1	950	90	90	51
Conley	13157	59.2	36	15.7	15.3	69.2	.38	66	2.25	74	2	980	90	90	54
R.L. 2563 x Lee	13159	59.2	31	16.2	15.4	65.6	.44	67	2.00	70	2	930	100	100	50
Thatcher x K338AC	13204	58.7	39	15.4	14.4	72.7	.39	63	2.25	74	2	975	85	100	57
Rushmore x K338	13205	59.0	39	15.8	14.7	69.7	.41	64	2.50	75	1	985	80	85	56
Ditto	13206	60.4	37	15.8	14.7	68.0	.41	66	2.50	74	1	960	85	95	54
N2350 x 4021-K338AC	13222	61.8	33	15.8	14.7	72.3	.39	67	2.00	73	2	980	90	85	56
N2350 x Thz.-K338AC	13223	61.5	36	16.1	15.0	71.3	.37	65	2.25	74	2	1000	85	90	56
K338AA x N2350	13224	60.0	37	15.0	14.0	71.4	.40	63	1.75	73	2	970	85	95	58
" x Ns3880.191	13301	62.0	31	15.4	14.5	72.5	.42	63	2.25	70	1	975	90	95	58
Ditto	13302	62.3	32	15.9	14.6	70.7	.41	65	2.25	71	1	973	90	90	56
Thatcher x Kenya Farmer	13211	61.5	38	15.7	14.4	70.7	.36	63	1.75	72	1	960	80	95	56
1953 x Lee	13242	60.3	37	14.6	13.6	71.9	.37	64	2.25	72	2	895	95	95	54
Lee x 1831	13243	59.6	33	14.4	13.6	74.5	.43	66	2.00	70	2	948	85	90	58

1/ Composite of seed from Dickinson, Minot, Moccasin, Havre, and Sidney.

Table 3.--Continued.

Average of the Eastern and Western Composites

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Gassing Power	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash					Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mn.	Mg.	Co.	Score	Score	Co.
Marquis	3641	58.5	31	14.8	13.9	70.8	.50	66	2.25	70	240	2	942	90	90	56
Thatcher	10003	59.3	30	15.6	14.7	70.6	.46	66	2.50	70	260	2	989	85	88	56
Selkirk	13100	58.1	35	15.4	14.6	72.9	.46	67	2.50	70	275	2	962	85	93	55
Lee	12488	59.5	34	16.3	15.1	69.4	.47	67	2.50	69	355	2	924	88	93	51
Lee^{6} x Kenya Farmer	13221	59.3	33	16.0	15.4	68.0	.47	68	2.25	69	375	1	940	88	90	51
Conley	13157	59.1	33	15.6	15.1	70.4	.45	68	2.50	72	300	2	949	88	88	52
R.L. 2563 x Lee	13159	59.1	29	16.0	15.2	67.9	.53	69	2.25	63	364	2	902	95	90	49
Thatcher x K338AC	13204	58.7	37	15.7	14.5	72.6	.47	66	2.50	73	330	2	965	88	93	56
Rushmore x K338	13205	58.9	37	15.8	14.4	71.9	.49	67	2.50	72	405	1	970	83	88	56
Do.	13206	60.2	34	16.0	14.6	69.8	.48	66	2.75	73	360	2	938	88	95	53
N2350 x 4021-K338AC	13222	61.5	31	15.9	14.6	72.6	.44	69	2.25	72	375	2	952	90	85	54
N2350 x Tha.-K338AC	13223	61.2	35	15.9	14.8	72.1	.40	64	2.50	73	269	2	963	90	90	54
K338AA x N2350	13224	59.7	32	15.4	14.4	71.8	.45	66	2.00	72	302	2	978	88	90	57
Do. x Ns3880.191	13301	61.7	30	15.4	14.5	71.8	.47	67	2.50	69	287	2	965	80	90	56
Do.	13302	62.0	30	15.9	14.7	71.5	.47	67	2.50	68	345	2	934	90	88	53
Thatcher x Kenya Farmer	13211	61.6	37	15.6	14.1	71.3	.41	65	2.25	67	273	2	918	83	90	54
1953 x Lee	13242	60.2	34	14.8	13.7	70.3	.42	67	2.50	70	288	2	878	93	93	52
Lee x 1831	13243	59.5	32	14.8	14.2	71.9	.50	69	2.50	67	390	2	916	85	90	53

Strain Lee^{6} x Kenya Farmer (R.L. 2937) has made fairly satisfactory bread. The loaf characteristics were good, the dough-mixing time, in the range of the approved hard red spring varieties and the bromate requirements, medium low. The dough-handling properties were found mellow and pliable, and similar to Marquis and Selkirk in this respect. The yield of flour was lower than expected, considering the test weight per bushel of the sample. The milling properties of the strain were not considered as satisfactory as those of the approved hard red spring varieties. The middlings were found difficult to reduce to flour, the principal reason for the questionable milling properties of this strain.

Strain R.L. 2563 x Lee (ND 3) produced a flour with materially higher ash content than Thatcher or Selkirk. Strain ND 3 had the lowest sedimentation value and specific loaf volume of the nursery grown samples. The milling properties were only fair.

The small differences in quality between a number of the strains have made it extremely difficult to rank the wheats. Most all produced bread that was satisfactory in grain with some better than others. The strains of good quality and those having many of the characteristics looked for in a wheat intended for bread were N2350 x 4021-K338AC (ND 44), K338AA x N2350 (ND 48), K338AA x Ns3880.191 (ND 49 and 55) and 1953 x Lee (B52-91). These wheats milled satisfactorily and produced a high yield of low to medium ash flour. The medium low pearling index values indicate that these strains are similar to the approved hard red spring varieties in hardness. The sedimentation values were high for all these strains indicative of a good gluten quality. The dough properties were strong and inclined to be bucky with the higher amounts of the oxidization agent, potassium bromate. The loaf volumes of the bread were high and the grain of the crumb good. These wheats appear to show promise for bread, according to one year's test.

There were a number of other strains making good bread, but the pearling index values of these wheats were higher than the approved hard red spring varieties. This higher pearling index value, indicating a softer textured wheat, may cause them to be objectionable to the milling trade. These strains were Thatcher x K338AC (ND 4), Rushmore x K338 (ND 12), N2350 x Th.-K338AC (ND 45), and Thatcher x Kenya Farmer (ND 33).

Gassing power determinations made on the flour as an indication of the diastatic activity or starch digesting enzymes reveal marked differences between some of the varieties and strains. Strain Rushmore x K338 (ND 12) was highest of the samples in gassing power followed by Lee; Lee^{6} x Kenya Farmer (R.L. 2937); R.L. 2563 x Lee (ND 3); Thatcher x K338AC (ND 4); Rushmore x K338 (ND 15); N2350 x 4021-K338AC (ND 44); K338AA x Ns3880.191 (ND 55) and Lee x 1831 (B52-119). There were a number of samples having low gassing power values (less than 300 mm.) which included some of the named varieties eg: Marquis, Thatcher, and Selkirk.

Mixogram patterns or curves have been made on the flour composited by variety and strain from the 18 eastern and western samples. The results of these tests (fig. 2) show that there were some differences in the dough characteristics between a few of the samples. The mixogram patterns for most of the named varieties were quite typical of good bread wheats and evidenced strong mixing properties. These varieties were Marquis, Conley, Thatcher, Selkirk, and Lee. A number of samples showed a rather rapid rise in the curve to the peak indicative of a quick dough development but this does not necessarily mean a lack of dough stability. These varieties and strains were R.L. 2563 x Lee (ND 3), K338AA x N2350 (ND 48), and Lee x 1831 (B52-119).

There were a number of strains, in addition to the named varieties, that showed good dough stability or mixing tolerance. These are as follows: Rushmore x K338 (ND 15); Thatcher x K338AC (ND 4); N2350 x Tha.-K338AC (ND 45); and K338AA x Ns3880.191 (ND 49). The mixogram curve for Thatcher x Kenya Farmer (ND 33) appears to be weaker than most of the wheats in this nursery.

State Nursery Trials

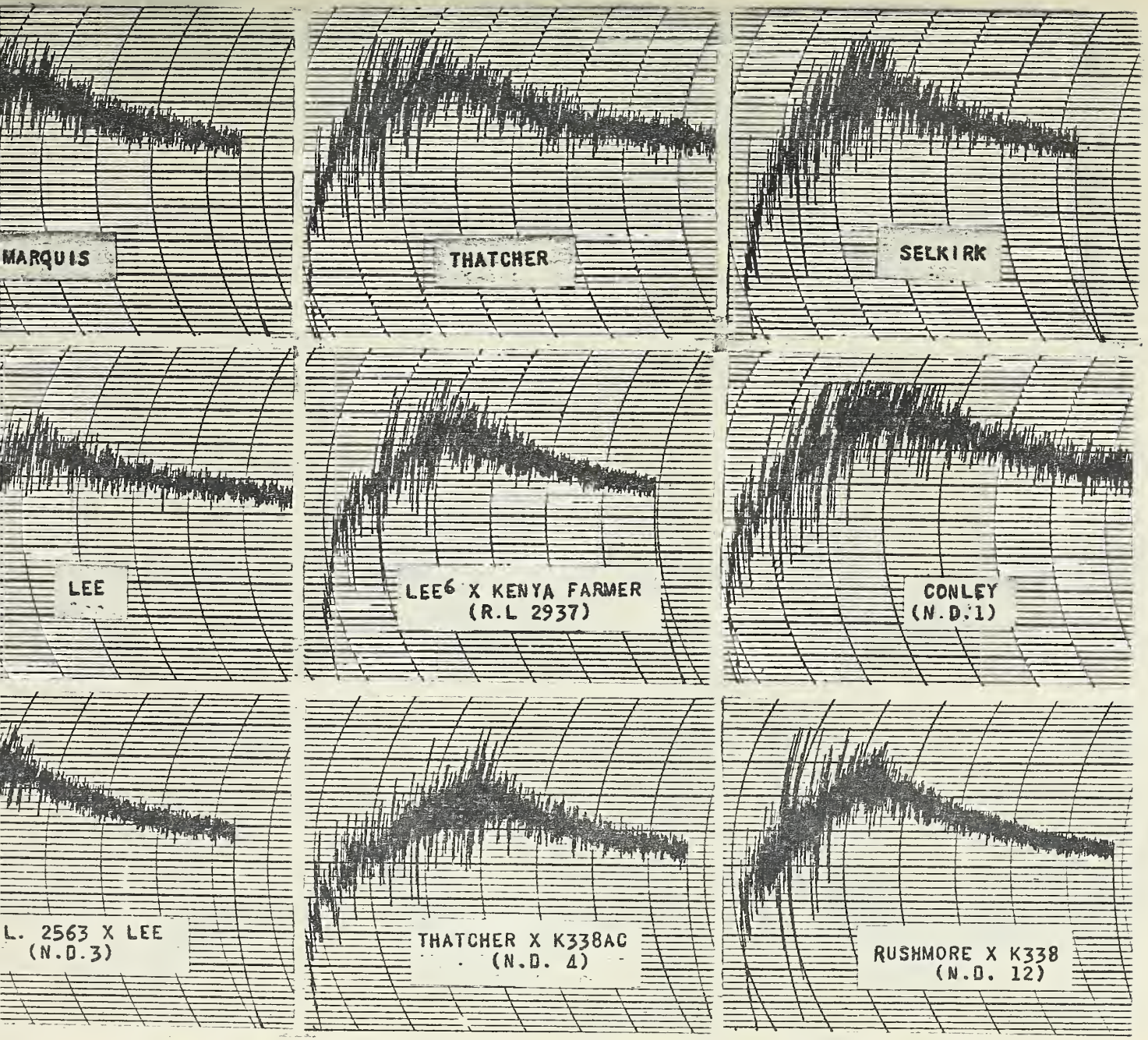
Results for the samples grown in the Montana State nursery trials are shown in table 4. These included samples on composites of a number of varieties and strains grown in the intrastate nursery at Moccasin, Havre, and Sidney, and from the advanced yield nursery at Moccasin, Havre, and Huntley, Montana.

Moccasin, Havre, and Sidney, Montana, Intrastate Nursery

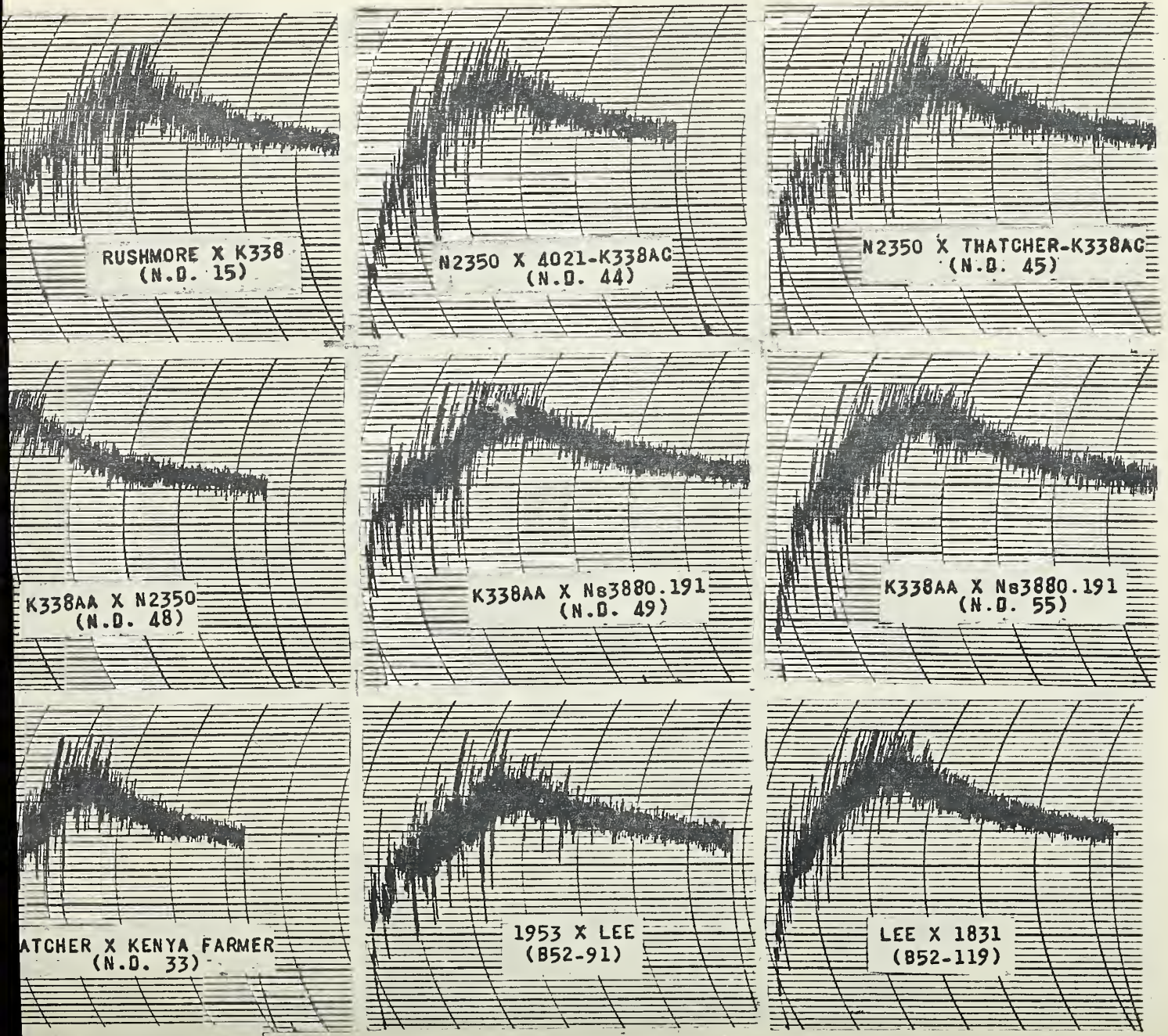
The differences in quality between the 16 samples from the intrastate nursery were not very great. These wheats have been classed into two groups for the purpose of discussion. All of the varieties and strains made satisfactory bread, with some samples slightly better than others.

The ranking of these samples was based to a large extent on a consideration of the data as a whole. The small differences in quality between the samples have made it rather difficult to rank the wheats. The milling and dough-handling properties have varied from good to very good. The dough-handling properties of 5 samples enumerated later were slightly bucky, but all the other samples from the Montana Intrastate Nursery were mellow and pliable. The crumb color scores were from fair to medium. Eight of the wheats made bread having crumb color scores of 70 to 75, which is considered only fair.

The high pearling index value of Thatcher x Lee (B55-10) indicates that this strain is softer than the approved hard red spring wheat varieties and possibly may not meet with the approval of the millers.



IGURE 2. MIXOGRAM CURVES OF THE HARD RED SPRING UNIFORM REGIONAL NURSERY SAMPLES



igure 2 (Continued)

Table 4.—Milling, baking, and chemical results on hard red spring wheats grown in State nursery trials, 1956 crop.

Variety or Cross	State or N. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Montana Intrastate Nursery[1]															
Thatcher x Lee	B55-13	59.6	37	15.8	15.0	69.7	.42	60	1.50	69	2	968	90	90	54
Thatcher x Lee	B55-21	58.4	37	15.9	14.7	70.5	.39	60	1.75	71	2	963	90	90	55
Awned Thatcher		58.2	37	16.6	15.6	70.6	.38	61	1.75	72	2	1038	80	85	56
Thatcher x Lee	B55-2	58.0	34	15.5	15.0	73.4	.46	61	1.75	65	2	985	85	90	55
Thatcher x Lee	B55-11	58.4	32	15.7	14.9	72.3	.39	60	2.00	72	2	998	75	80	56
Thatcher x Lee	B55-1	57.2	34	15.3	14.6	68.6	.42	61	1.75	69	2	973	80	90	56
Thatcher x Lee	B55-5	58.5	38	15.3	14.8	72.7	.40	60	2.00	72	1	1002	75	90	57
Thatcher x Lee	B55-8	58.1	39	15.6	15.3	71.8	.42	61	2.00	72	1	1035	75	85	57
Thatcher x Lee	B55-10	58.0	43	15.8	15.1	72.6	.40	60	2.00	74	2	1033	75	90	58
Lee	12488 (C.I.)	59.4	38	16.1	15.1	70.8	.41	63	2.00	70	1	933	85	90	51
Thatcher^2 x Pilot	N2170	58.9	33	15.6	14.7	71.1	.39	61	2.00	72	2	980	75	90	56
Thatcher x Lee	B55-12	59.7	36	15.5	15.1	73.6	.40	61	1.50	65	2	995	80	85	55
Thatcher x Lee	B55-4	58.5	38	15.2	14.5	72.5	.38	60	2.00	73	1	1005	75	95	58
Thatcher x Lee	B55-19	58.6	40	16.3	15.2	70.0	.40	61	1.75	74	1	1010	80	95	56
Thatcher	10003 (C.I.)	58.4	34	16.3	15.5	71.4	.39	61	2.00	72	1	1050	70	85	57
Thatcher x Lee	B55-9	57.7	36	15.7	15.3	73.7	.40	61	2.25	72	2	1015	70	85	56

1/ Composite of Sidney, Havre, and Moccasin, Montana.

Table 4.--Continued.

Variety or Cross	State or N. No.	Test Weight	Pearling Index Value	Protein: Wheat	Protein: Flour	Flour: Yield	Flour: Ash	Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method: Bromate	Optimum Baking Method: Loaf Volume	Optimum Baking Method: Crumb: Color	Optimum Baking Method: Crumb: Grain	Specific Loaf Volume
		Lb.	Pot.	Pot.	Pot.	Pot.	Pot.	Pot.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Montana Advanced Yield Nursery 1/															
Lee x 1831	B52-120	59.0	31	16.2	15.0	69.8	.43	60	2.25	67	2	1005	75	95	56
Marquis	3641 (C.I.)	59.6	31	15.4	14.2	72.8	.42	61	2.00	64	3	1005	85	90	60
Lee	12488 "	59.0	38	16.3	15.5	71.4	.44	62	2.00	68	1	950	85	90	51
2236 x Lee	B52-107	56.1	36	16.1	15.3	72.8	.47	62	2.25	68	2	963	85	90	52
1898 x Lee	B52-57	58.1	34	16.9	16.3	73.3	.50	65	2.50	71	2	1010	85	85	52
Lee x 1831	B52-119	58.0	35	15.1	14.2	74.6	.44	63	1.75	68	2	945	75	90	55
Conley	ND 1	57.3	35	16.1	15.5	72.8	.42	65	2.50	73	2	983	80	85	53
Russell	12484 (C.I.)	55.1	32	16.7	15.7	71.5	.42	62	2.50	74	2	995	70	90	53
1953 x Lee	B52-92	57.4	36	15.4	14.9	74.5	.43	61	2.00	70	2	1013	80	90	57
1520 x 1752	N2389	61.1	33	15.6	14.6	74.3	.41	62	1.75	69	1	958	95	95	55
Rescue x 1831	B51-9	58.5	33	16.2	15.5	74.6	.43	61	2.00	71	1	1035	75	85	56
Rescue	12435 (C.I.)	57.6	36	16.5	15.8	72.0	.43	60	2.00	72	1	1043	75	85	56
Pilot	11945 (C.I.)	56.5	29	16.6	15.8	70.8	.48	62	2.25	72	1	1023	65q	85	55
1953 x Lee	B52-91	58.6	36	15.7	14.5	75.4	.40	62	2.50	69	1	965	85	95	56
Ceres	6900 (C.I.)	59.0	29	16.1	15.3	70.2	.46	62	2.50	72	1	993	80	90	54
Lee x Mida	3880.127	59.3	34	16.8	15.7	71.1	.45	62	2.25	65	1	975	90	95	52
Thatcher	10003 (C.I.)	56.5	33	16.8	16.0	71.6	.44	62	2.25	71	2	1075	65q	80	57
Pilot^2 x Regent	N2183	57.5	32	16.4	15.4	72.2	.46	60	2.00	72	2	1005	95	90	55
R.L. 2563 x Lee	ND 3	58.0	30	16.5	15.8	70.0	.57	63	2.25	66	1	865	80	90	45
Pilot^2 x Merit	N2164	57.6	26	16.1	15.4	67.4	.55	64	2.25	68	2	923	75	80	50
Selkirk	13100 (C.I.)	55.0	34	15.4	15.1	74.1	.46	63	2.00	72	2	1013	95	95	56
Rescue x Tha.-S-615	B51-43	59.0	32	16.1	15.5	70.7	.43	61	2.00	71	2	868	80	75	46
Centana	N2170	57.5	26	16.8	15.9	71.1	.45	60	2.25	71	1	1013	85	80	54
Chinook	H4258	60.0	36	16.1	15.6	73.3	.41	60	2.25	70	1	975	85	90	52
Rescue x Tha.	B50-18	61.1	35	15.4	15.1	73.4	.43	60	2.00	71	2	970	75	90	54
1953 x Lee	B52-90	60.4	35	16.3	15.3	71.9	.42	60	1.75	71	1	928	95	90	50
1953 x Lee	B52-94	58.6	37	16.0	15.0	72.8	.42	62	1.75	70	1	918	80	95	51

1/ Composite of Moccasin, Havre, and Huntley, Montana.

Those samples making the best bread and scoring high in most of the quality properties were ranked first. These are as follows: Thatcher x Lee (B55-21); Awned Thatcher; Thatcher x Lee (B55-2); Thatcher x Lee (B55-1); Lee; and Thatcher x Lee (B55-19).

Of the 10 samples ranking second, Thatcher x Lee (B55-13) was deficient in dough-handling properties and was next to the lowest in flour yield of the varieties and strains tested in this group. Nine other samples were ranked second best because of their slightly lower crumb color scores. These were Thatcher x Lee (B55-4, 5, 8, 9, 10, 11, and 12), Thatcher^2 x Pilot (N2170), and Thatcher. The dough handling properties of Thatcher x Lee (B55-11), Thatcher, and Thatcher x Lee (B55-9) were strong and bucky. The varieties and strains ranking second best were slightly lower in 2 or 3 quality properties, but all 16 samples, however, ranked high in most properties for which tests have been made.

Moccasin, Havre, and Huntley, Montana, Advanced Yield Nursery

All the wheats were relatively high in protein content with none lower than 14.2 percent in the flour. This accounts, no doubt, in part, for the good quality of many of these wheats for bread-making. Most of the samples with the exception of two milled satisfactorily, although many were low (57.0 pounds or less) in test weight per bushel. Strains R.L. 2563 x Lee (ND 3) and Pilot^2 x Merit (N2164) were deficient in milling properties and had the highest flour ash content of the wheats in this group of samples.

The flour yield was remarkably good for most of the samples considering the test weight per bushel of the grain. Those having the best yields of flour (74.0 percent or higher) were Lee x 1831 (B52-119); Selkirk; 1953 x Lee (B52-91 and 92); 1520 x 1752 (N2389), and Rescue x 1831 (B51-9). Strains Pilot^2 x Merit (N2164) and Lee x 1831 (B52-120) were lowest of the nursery samples in yield of flour.

Thatcher and Pilot, of the approved and named hard red spring varieties were rated down principally because of the low crumb color of the bread. Otherwise, they appeared to be strong wheats. Selkirk made an excellent loaf of bread, had a low flour ash content and produced as already mentioned, an exceptionally high yield of flour. Conley made good bread, which was very similar in quality to Marquis, Ceres, and Lee. The crumb color of bread from Thatcher and Russell was poorer than usual for these varieties. Chinook and Centana appear to have made satisfactory loaves of bread.

The strains that appear to be the best in quality, considering the data as a whole, were 2236 x Lee (B52-107); 1953 x Lee (B52-90; 91, 92, and 94); 1520 x 1752 (N2389); Pilot^2 x Regent (N2183); and Lee x Mida (3880.127). It is interesting that the cross 1953 x Lee has produced four good quality wheats, all exceptionally satisfactory for bread.

Strains Rescue x That.-S615 (B51-43) and R.L. 2563 x Lee (ND 3) were lower in loaf volume than expected considering their flour protein contents. Both of these had low specific loaf volumes, but reasonably high sedimentation values. Many of the samples produced bread having loaf volumes of 1,000 cc. or higher. The dough-mixing times for the strains were satisfactory and about the same as that of the approved hard red spring varieties.

International Sawfly Yield Nursery

The results for a number of varieties and strains resistant to wheat stem sawfly grown in the International Sawfly Yield Nursery trials at Froid, Medicine Lake, Moccasin, and Dutton, Montana, are shown in table 5. These trials include many strains of current interest. One of the principal interests in these tests is a comparison of the quality of the strains which include Rescue in their parentage, with that of Thatcher and Rescue.

The quality results have been discussed to a large extent on a consideration of the data as a whole.

All the varieties from Moccasin, Montana, made acceptable bread with little difference in quality between any of them. Conley was perhaps the best quality wheat among the Moccasin samples followed by Thatcher, Lee, and Selkirk. Thatcher was strongest in dough quality, but it was also highest of the varieties in protein content.

The varieties and strains from the Sawfly Yield Nursery made bread that was high in loaf volume, and the grain of the bread was good. The greatest difference between the samples was perhaps in the crumb color of the bread. All of the samples milled satisfactorily and their dough-handling properties were generally strong and elastic. Five of the wheats produced a yield of flour of 75.0 percent or higher. These were: Selkirk; Chinook; Rescue x Chinook (C.I. No. 13309); Rescue x Thatcher (C.I. No. 13244); and Rescue x 1831 (C.I. Nos. 13311 and 13304). This is an important property of a wheat intended for bread-making purposes. Those samples highest in water absorption of flour and exceeding Rescue in this respect were Selkirk; Rescue x Thatcher (C.I. Nos. 13244 and 13307); Rescue x Cadet (C.I. No. 13312); and Rescue x Chinook (C.I. No. 13308).

Five of the varieties and strains, considering the data as a whole, appear to have made the best bread of the group. These are Selkirk; Chinook; Rescue x Chinook (C.I. No. 13309); Rescue x Thatcher (C.I. Nos. 13244 and 13306); and Lee. The loaf volume, internal bread characteristics, and other quality properties of these were satisfactory. Those ranking next principally because of lower internal bread scores were: Rescue x Chinook (C.I. Nos. 13310 and 13308), and Rescue x Cadet (C.I. No. 13314). Those considered next best in general quality were: Rescue; Thatcher; Rescue x Cadet (C.I. No. 13312); Pilot[2] x Thatcher (C.I. No. 12974); Rescue x 1831 (C.I. No. 13304); Rescue x Chinook (C.I. No. 13313); and Rescue x Thatcher (C.I. No. 13307).

Table 5.—Milling, baking, and chemical results on hard red spring wheats grown in the International Sawfly Yield Nursery, 1956 crop.

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Selkirk	13100	57.4	34	14.1	13.4	75.7	.41	68	2.25	70	2	963	100	95	60
Chinook	13220	61.2	37	14.9	14.0	75.1	.37	64	2.00	68	2	1000	90	85	60
Rescue x Chinook	13309	60.4	35	14.7	13.9	75.3	.40	65	2.50	69	1	1025	90	95	62
Rescue x Chinook	13310	60.8	40	15.6	14.8	72.8	.39	66	2.50	72	1	1060	85	85	61
Rescue	12435	59.8	38	14.1	13.6	74.9	.40	65	2.25	74	1	1050	80	90	65
Rescue x Thatcher	13306	60.7	36	14.5	13.6	74.2	.40	66	2.25	70	1	1013	90	85	63
Rescue x Thatcher	13244	62.3	35	14.4	13.5	76.7	.42	68	2.25	69	1	1038	95	90	65
Rescue x Cadet	13314	60.8	33	14.6	14.2	74.5	.42	67	2.50	70	2	1050	85	85	63
Lee	12488	59.4	38	15.3	14.5	73.4	.42	66	2.25	70	2	1043	90	85	61
Thatcher	10003	58.9	34	15.0	13.9	73.5	.39	67	2.25	71	1	1013	60q	100	61
Rescue x Cadet	13312	60.3	30	14.3	13.6	72.7	.41	68	2.50	72	2	920	70	90	56
Rescue x Thatcher	13307	61.7	37	14.9	14.2	74.6	.39	70	2.50	66	2	1008	70	85	60
Rescue x 1831	13311	61.5	29	13.4	12.4	75.6	.40	65	2.75	67	1	915	65q	85	61
Rescue x Chinook	13315	60.2	34	14.1	13.1	73.4	.36	65	2.00	71	1	868	65q	80	54
Pilot[2] x Thatcher	12974	60.1	31	14.2	13.0	73.8	.38	65	1.75	69	2	988	85	85	64
Rescue x 1831	13304	60.6	33	14.2	13.5	75.7	.38	66	2.00	67	1	980	75	85	61
Rescue x Chinook	13313	60.7	35	14.2	13.5	74.7	.37	66	2.75	71	2	960	75	85	59
Rescue x Chinook	13308	60.7	32	14.3	13.7	74.1	.38	68	2.75	71	2	973	85	90	59

These varieties and strains were rated lower in quality than the previous samples because of generally lower internal bread scores or, in one instance, a short dough-mixing time. The variety Thatcher which had good dough properties and is considered a strong wheat produced bread of poor crumb color. It was lowest in this respect of the samples tested in this nursery composite.

Strains Rescue x 1831 (C.I. No. 13311) and Rescue x Chinook (C.I. No. 13315) made perhaps the poorest bread of the samples from this nursery. These strains were of medium low strength and produced bread of lower loaf volumes and generally lower internal bread properties than the other samples.

Commercial Samples

As in past years, a number of commercially-grown wheat samples were obtained through the Grain Division, Agricultural Marketing Service, for comparison with the varieties and strains produced in experimental plots. Seventeen such samples, representing a number of grades and subclasses were obtained at Great Falls, Montana, and Minneapolis and Duluth, Minnesota. The samples were composited by grade from 2,738 cars of wheat grading No. 3 or better. This is the eighteenth season such samples have been tested. The results are given in table 6.

These samples generally averaged lower in protein content than the varieties and strains grown in experimental plot and nursery trials. The Great Falls, Montana, samples average 14.1 percent protein while the Duluth and Minneapolis, Minnesota, samples were somewhat lower, averaging 13.6 and 13.5 percent, respectively. The milling characteristics were much alike for the commercial and experimental samples with the commercial samples possibly slightly higher in yield of flour. Otherwise, the baking and chemical results do not appear to be greatly different when compared with samples having approximately the same protein content.

Notes on Some of the New Strains of Current Interest

Each year many new strains of wheats are tested along with the leading commercial varieties for chemical composition, milling, and bread-baking quality. The data on 2 strains and 3 varieties of current interest with averages expressed as a percentage of comparable samples of Lee are shown in table 7.

Selkirk (C.I. No. 13100)

Selkirk is a Canadian developed variety showing resistance to 15B stem rust at low temperatures and has been approved for distribution in Canada and the United States.

Table 6.—Milling, baking, and chemical results on 17 composite commercial samples from 2,738 cars of hard red spring wheat obtained at Duluth, Minneapolis, and Great Falls, representing the 1956 crop.

Location Where Obtained	U.S. Grade	No. of Cars	Test Weight	Pearling Index Value	Flour Yield	Wheat Protein	Flour Protein	Flour Ash	Water Absorption	Mixing Time	Sedimentation Value	Optimum Bake Bromate	Optimum Bake Loaf Volume	Optimum Bake Crumb Color	Optimum Bake Grain Texture	Specific Loaf Volume
			Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Great Falls, Mont																
Do.	1HDNS	373	61.0	30	69.3	14.0	13.3	.43	64	2.50	64	1	868	90	85	53
Do.	1DNS	281	59.6	32	69.3	14.5	13.5	.40	62	2.25	69	1	900	90	90	55
Do.	2DNS	139	60.7	33	64.6	13.6	13.3	.41	65	2.25	68	1	895	85	90	55
Do.	2DNS	192	60.6	31	72.8	14.7	13.9	.47	63	2.25	69	2	943	90	85	53
Do.	3DNS	80	61.0	33	73.7	13.9	12.8	.47	64	2.50	68	1	915	85	85	59
Average			60.6	32	69.9	14.1	13.4	.44	64	2.35	68	1.2	904	88	87	55
Duluth, Minn.																
Do.	1HDNS	232	60.8	35	73.0	14.4	13.5	.39	62	2.25	68	1	983	90	90	61
Do.	1DNS	522	59.7	36	69.3	14.1	13.3	.42	62	2.25	64	1	990	100	95	62
Do.	2DNS	185	59.3	34	72.4	14.1	13.3	.44	62	2.50	65	1	985	95	95	62
Do.	1NS	175	59.4	38	76.9	13.2	12.5	.43	63	2.25	62	2	915	90	90	60
Do.	3DNS	93	58.3	32	73.5	13.2	12.5	.44	62	2.25	64	1	945	90	95	63
Do.	2NS	129	58.7	36	75.2	13.2	12.3	.43	62	2.25	61	1	938	95	95	63
Do.	3NS	92	57.2	33	75.4	12.9	12.4	.46	62	2.25	59	2	928	80	95	62
Average			59.1	35	73.7	13.6	12.8	.43	62	2.29	63	1.29	955	91	94	62
Minneapolis, Minn.																
Do.	1HDNS	55	61.1	35	74.0	14.0	13.4	.43	60	2.25	66	1	933	90	95	58
Do.	1DNS	70	59.9	36	75.6	13.8	13.1	.46	63	2.25	67	2	910	85	90	57
Do.	2DNS	45	58.4	36	75.0	13.6	12.7	.44	63	2.00	64	2	920	90	100	60
Do.	3NS	45	57.2	38	74.7	13.0	12.1	.45	60	2.25	39	1	865	85	90	58
Do.	3DNS	30	56.9	30	73.1	12.9	12.0	.44	60	2.50	57	1	865	90	90	59
Average			58.7	35	74.5	13.5	12.7	.44	61	2.25	59	1.40	899	88	93	58

Table 7.—Comparison of the test weight per bushel, milling, baking, and chemical properties of a number of varieties and strains of wheat with the variety, Lee, 1956 crop.

Variety or Cross	No. of samples	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Sedimentation Value	Optimum Baking Method				Specific Loaf Volume
				Wheat	Flour	Yield	Ash				Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Ml.	Mg.	Cc.	Score	Score	Cc.
Selkirk	18	57.9	34	14.6	13.8	74.5	.46	66	2.22	64	1.83	952	88	92	57
Lee	18	59.4	33	15.4	14.5	70.5	.46	67	2.39	64	1.50	926	88	92	53
Percentage of Lee		97.5	103.0	94.8	95.2	105.7	100.0	98.5	92.9	100.0	122.0	102.8	100.0	100.0	107.5
Conley	17	59.0	32	14.9	14.1	72.9	.43	67	2.54	67	1.65	929	89	91	54
Lee	17	59.3	33	15.4	14.4	70.3	.46	67	2.40	63	1.47	919	88	92	52
Percentage of Lee		99.5	97.0	96.8	97.9	103.7	93.5	100.0	105.8	106.3	112.2	100.1	101.1	98.9	103.8
Russell	6	58.1	31	13.4	12.1	73.7	.43	63	2.55	58	1.50	830	79	87	56
Lee	6	58.3	31	15.0	14.0	70.2	.49	66	2.38	58	1.20	867	85	89	51
Percentage of Lee		99.7	100.0	89.3	86.4	105.0	87.8	95.5	107.1	100.0	125.0	95.7	92.9	97.8	109.8
Lee x 1831 B52-119	4	59.0	33	14.9	14.2	72.9	.48	69	2.17	62	1.7	925	82	90	54
Lee	4	59.6	34	16.2	15.3	70.3	.47	65	2.25	64	1.8	936	90	94	51
Percentage of Lee		99.0	97.1	92.0	92.8	104.0	102.1	106.2	96.4	96.9	94.4	98.8	91.9	95.7	105.9
Lee[6] x Kenya Farmer	2	59.3	33	16.0	15.4	68.0	.47	68	2.25	69	1.00	940	88	90	51
Lee	2	59.5	34	16.3	15.1	69.4	.47	67	2.50	69	2.00	924	88	93	51
Percentage of Lee		99.7	97.1	98.2	102.0	98.0	100.0	101.5	90.0	100.0	50.0	101.7	100.0	96.8	100.0

Comparable milling and baking tests of 18 samples show that Selkirk is very similar to Lee for many of the characteristics for which comparisons have been made. It has produced a higher yield of flour, although 1.5 pounds lighter in test weight per bushel than Lee. It milled satisfactorily and made a granular flour similar to the approved varieties in this respect. Selkirk averaged slightly lower in protein content (0.8 percent in the wheat and 0.7 percent in the flour) than Lee. The dough properties of Selkirk were good, being elastic and pliable. Selkirk required 22 percent more potassium bromate for optimum bread than Lee. It made satisfactory bread slightly exceeding Lee in bread loaf volume. This is a good bread wheat and has many of the favorable properties found in the approved hard red spring varieties.

Conley, ND 1, (C.I. No. 13157)

Comparable milling and baking tests of 17 samples show that the variety Conley had from good to very good milling characteristics. It is about the same or better than Lee in flour yield, water absorption, mixing time, bromate response, loaf volume, bread crumb color, and grain. Conley is approximately the same as Lee in test weight, flour ash, and dough-handling properties. The doughs were generally mellow and pliable for the samples grown at most stations. The possible exception to this was the samples from Morris and Waseca, Minn., Minot, N. Dak., and the Eastern Composite Nursery where the doughs were either slightly weak or short and bucky. This variety has generally made a good showing for most of the characteristics and has produced bread that is equal, if not better, than the variety Lee. The sedimentation tests on the 17 Conley samples averaged higher than the comparable samples of Lee which indicates, in general, that Conley has slightly higher bread-baking strength than Lee.

Lee^{6} x Kenya Farmer, R.L. 2937 (C.I. No. 13221)

Two samples of Lee^{6} x Kenya Farmer tested in 1956 indicate that it is very similar to Lee in test weight per bushel, pearling index, protein content of wheat and flour, flour ash, water absorption, loaf volume, crumb color, and sedimentation value. It had a satisfactory dough-mixing time and good mixing tolerance and was similar to the approved hard red spring varieties in this respect. It required about half as much potassium bromate for maximum loaf volume as that of Lee. The Eastern Composite Nursery sample of Lee^{6} x Kenya Farmer milled good, but the Western Composite Nursery sample milled only fair, the middlings bolted slow and were difficult to reduce to flour. It produced about 1.4 percent less flour (average of both samples) than Lee, although both had about the same test weight. This strain may prove to have some unsatisfactory milling properties. The dough-handling properties of Lee^{6} x Kenya Farmer, R.L. 2937 for the Eastern Composite were fair, and the dough was short and not pliable. The dough-handling properties for the Western Composite were mellow and pliable. The results from these 2 samples indicate that this strain is a promising bread wheat.

Lee x 1831, B52-119 (C.I. No. 13243)

Comparable milling, baking, and chemical tests of 4 samples of Lee x 1831 show that it is generally similar to Lee except for protein content. Here it averaged 1.3 percent lower in wheat protein than Lee. Both, however, made bread of approximately the same loaf volume. The mixogram pattern or curve for Lee x 1831 appears to be very similar to the approved hard red spring varieties, Selkirk and Marquis. The quality of the gluten appears to be relatively good, especially when considering the specific as well as the actual loaf volume of the bread made from Lee x 1831. Strain Lee x 1831 milled from good to very good except for the sample from the Eastern Composite Nursery. This sample milled only fair, the middlings being difficult to grind. The dough-handling properties of the sample from Newell, S. Dak., were sticky while the other samples were satisfactory, being mellow and pliable. It averaged 2.6 percent higher in flour yield and 4.0 percent higher in water absorption than Lee. Lee x 1831 was similar to Lee in test weight per bushel, pearling index, flour ash, dough-mixing time, bromate requirements, bread grain, and sedimentation value, but lower in crumb color. The results obtained on the few samples tested of this strain Lee x 1831, B52-119 (C.I. No. 13243) indicate that it has a number of the properties of a good bread wheat.

Russell, Wis. No. H-195-45 (C.I. No. 12484)

Russell, a new spring wheat variety, is Wis. No. H-195-45 and was developed by the University of Wisconsin and the U. S. Department of Agriculture. Its resistance to loose smut, powdery mildew, and hessian fly along with its moderate resistance to most prevalent races of stem rust, make it a high yielding variety in the areas of Wisconsin where these diseases generally reduce yields of the present varieties.

The weighted average of six comparable samples shows that Russell differs from Lee in a number of the properties for which comparisons were made. It was about the same in test weight per bushel, but produced 3.5 percent more flour than Lee. The flour was granular, but perhaps slightly softer than that of Lee. The flour was not as soft as that milled from the variety Henry, a wheat grown for some time in Wisconsin. The most significant difference in this year's tests is the much lower wheat protein content of Russell which averaged 1.6 percent lower than that of the comparably grown samples of Lee. The dough-mixing time of Russell was about the same, but the crumb color of the bread lower than that of Lee. The dough-handling properties of Russell were mellow and pliable, but not considered as strong as most of the approved hard red spring varieties. The specific loaf volume was high, indicative of a fairly good gluten quality. Russell has made a loaf of bread of nearly the same volume as Lee, although the latter variety was much the higher (1.9 percent) of the two in protein content. Russell appears to be a better wheat than a number of the Wisconsin-grown varieties.

Centana, N2170 (C.I. No. 12974)

The variety Centana, a U.S.D.A. selection, developed in cooperation with the Montana Agricultural Experiment Station, is a cross between Pilot x Thatcher. Considerable interest is being shown in Montana for releasing this variety in that State. A number of averages (table 8) of the chemical, milling, and baking data for Centana grown comparably with Thatcher, Lee and Rescue have been made. These averages cover a period of 9 years testing with Thatcher and a 5-year period with Rescue and Lee. Because the release of Centana is being considered in Montana, data from the various years' tests are shown and discussed.

The milling properties of Centana were satisfactory and the yield of flour about that expected for the test weight per bushel of the grain. It produced about the same amount of flour as Thatcher, Lee and Rescue. The ash content of the flour from Centana was low, water absorption high, dough-mixing time and bromate requirements much the same as the three varieties included for comparison. The dough-handling properties of Centana, which are elastic and pliable, have been somewhat more mellow than those of Thatcher. The wheat protein content of Centana has averaged slightly lower than Lee or Thatcher but is higher than Rescue. There is one property of Centana that appears to be consistent over the years of our tests. The protein content of the Centana flour averaged lower than generally expected considering the protein content of the wheat. For example, there was a spread in protein content between the wheat and flour of 1.0 percent for Centana, 0.7 percent for Thatcher, 0.8 percent for Rescue, and 1.2 percent for Lee. One favorable property of Centana that our results showed in spite of its comparative lower wheat-flour protein relationship, was the good loaf volume it produced in comparison to Lee and Thatcher. Here Centana with a flour protein content of 14.3 percent produced a loaf volume of 934 cc. while the comparably grown 17 Thatcher samples having a 15.0 percent flour protein made a loaf of only slightly higher being 958 cc. The 5 Lee samples produced a loaf volume of 854 cc. for a 15.0 percent flour protein, as compared with a 913 cc. loaf volume for Centana with a lower protein of 14.4 percent. Centana was the same as Rescue in protein content and loaf volume. Another favorable characteristic of Centana is its better crumb color of the bread, which averages about 5 to 10 points better than either Rescue or Thatcher. Centana has some promising characteristics in common with the approved hard red spring wheat varieties.

Table 8.--Average quality characteristics of Centana, Lee, Thatcher, and Rescue grown in Montana from 1948 to 1956.

	Centana N2170 C.I.No.12974	Thatcher C.I. No.10003	Centana N2170 C.I.No.12974	Lee C.I. No.12488	Rescue C.I. No.12435
Years tested	1948-1956		1952-1956		
Number of samples	17		5		
Wheat:					
Test weight (bu.)	59.6	58.0	58.5	58.7	58.2
Pearling index value (pct.)	29.0	30.0	30.0	36.0	35.0
Protein:					
Wheat (pct.)	15.3	15.7	15.7	16.2	15.2
Flour (pct.)	14.3	15.0	14.4	15.0	14.4
Flour:					
Yield (pct.)	72.2	72.0	72.7	71.3	72.9
Ash (pct.)	.42	.45	.43	.44	.43
Bread: (pan)					
Absorption (pct.)	63.0	64.0	60.0	60.0	59.0
Mixing time (min.)	2.07	2.13	2.00	1.95	1.95
Bromate (mg.)	0.8	1.2	1.0	1.4	1.2
Loaf volume (cc.)	934	958	913	854	912
Crumb color (score)	85	80	89	89	79
Crumb grain (score)	86	87	88	91	91
Specific loaf volume (cc.)	54	53	52	46	52